INTERNET DOCUMENT INFORMATION FORM

A. :Report Title: Sustaining Flight Through the Power of Knowledge

B. DATE Report Downloaded From the Internet _18 Mar 98

C. Report's Point of Contact: (Name, Organization, Address, Office Symbol, & Ph #): The Under Secretary of Defense for Acquisition and Technology

D. Currently Applicable Classification Level: Unclassified

E The foregoing information was compiled and provided by:
DTIC-OCA, Initials:___PM_____**Preparation Date**:18 Mar 98

DIST-A

The foregoing information should exactly correspond to the Title, Report Number, and the Date on the accompanying report document. If there are mismatches, or other questions, contact the above OCA Representative for resolution.

"Sustaining Flight Through the Power of Knowledge"

Ira C. Eaker
Distinguished Lecture on National Defense Policy

Address of
The Under Secretary of Defense for Acquisition and Technology
Dr. Paul G. Kaminski
to the
United States Air Force Academy
Colorado Springs, CO

May 2, 1996

In June of 1960—nearly 36 years ago, I made my first trip to the Air Force Academy to enter with the Class of 1964. That trip led to an incredible set of experiences that continue today. It is always great to return here, but truly special for me to have the opportunity to meet with you—the leaders of today and tomorrow.

So much has changed since I graduated from the Air Force Academy in 1964. In 1964, with a college degree and a few years of experience, one could reasonably expect to have one career, maybe one-and-a-half careers. But even for my generation, our expectations have had to change: I am already in my third career. I spent the first 20 years of my professional life as an Air Force Officer. In my Air Force career, I experienced a diversity of interesting, challenging and out-of-the-ordinary assignments. I spent he next 10 years as a founding partner and eventually as CEO of an investment banking and consulting firm, and the last 20 months as a presidential appointee in government.

Today's Air Force Academy graduates will face far more dramatic changes—than I did. The Air Force itself is going through dramatic changes. One enduring principle that I have found to be a foundation in the midst of these continuing changes, something I first embraced during my doolie year at the Academy, is the inscription on the Eagle and Fledging statue outside Mitchell hall: "Man's Flight Through Life Is Sustained by the Power of his Knowledge." This afternoon, I want to talk to you about how the power of knowledge will sustain today's graduates and America's armed forces in this time of accelerating change.

Today's graduates have to anticipate a lifetime of keeping pace with change. Just think of the scope of change in my lifetime—it is truly astonishing. We have gone from slide rules and french curves to Pentiums and AutoCAD. From CNN to jet airplanes, much of the nation's progress is driven by the information revolution and advances in semiconductor integrated circuits. The general trend we have seen since the

1970s has been about a ten-thousand fold improvement in integrated circuit capability at nearly the same cost.

These advances have been made by increasing the number of gates per chip by decreasing the minimum feature size of a chip device at a rate described by Moore's Law. This empirical relationship says that chips get twice as powerful every 18 months. The same $2500 that bought the original Macintosh in 1984, a machine with 128 K of random access memory (RAM) and the Motorola 68000 processor, now buys a color Performa with 8MB of RAM, a heavy-duty 601 RISC chip, and a quad-speed CD-ROM drive.

We project another thousand fold improvement over the next 15 years at the rate of advance predicted by Moore's Law. At that point, we may run into the practical limit as feature sizes approach the size of a few hundred silicon atoms and quantum effects come into play. But this type of limit has been 10 to 15 years away for the past 15 years and we have continued to move forward. Think about another thousand fold improvement—this is what will continue to drive the information revolution.

The information revolution is having a dramatic impact on how today's graduates prepare for their careers, and how alumni sustain theirs. I recently saw a study of course descriptions for college engineering classes. The study found that the half-life for the material covered in these courses is about 5 to 10 years. And engineering library reference documents tend to have an even shorter useful half-life—only one to two years.

Our knowledge base is expanding at a staggering rate. While there were roughly 100 scientific journals in 1800, there are almost 100,000 today. This knowledge explosion has not been limited to just the scientific and technical fields—it is said that mankind's knowledge has doubled between 1965 and 1990 and it will double again at the turn of the century. The President of World Trends Research claims that; "If you were to read the entire Sunday New York Times, you would be exposed to more information in that one reading than was absorbed in a lifetime by the average person living in Thomas Jefferson's day."

You must develop an approach to constantly enhance your knowledge base just to keep up. In a sense, graduation now signifies only the beginning of an education, not the end. The trends support this observation: the number of students 25 or older in U.S. colleges and universities has nearly tripled, from 2.4 million in 1970 to 6.3 million in 1993. Those students now make up nearly half the college population. During the same time, the number of people 35 or older who have returned to college has more than tripled. And not only are people going to have to constantly re-educate themselves to deal with a knowledge base that is turning over faster, we are going to have more time to do it—the average American life span has increased by about 25 years in this century.

Longer lifespans and the rapid turnover in knowledge imply that today's graduates must be prepared to change careers many times. The power of knowledge through some form of continuing education will provide the fuel to allow them to do so.

As you prepare for change in your own personal and professional lives, you also must prepare for a changing Air Force. America's armed forces are going through a dramatic transformation--everything from objectives and strategy to weapons and force structure to doctrine and tactics. The world is changing, and just like the larger civilian society that we protect and serve, so to must we adapt to the changes driven by the information revolution.

At the time I was born, the country had one overriding national security objective: to win the Big War. We did that. In 1964, our objective was to deter a Bigger War. We have done that too. Now our objective is deter smaller wars and the use of weapons of mass destruction—the so-called NBC weapons—nuclear, biological and chemical.

One of the moments that I want to share with you--one that helps in understanding the fundamental change in our approach to national security--was a trip that I made last year with Secretary of Defense Bill Perry to four of the former Soviet republics--Russia, Ukraine, Kazakhstan and Uzbekistan.

We visited a missile silo near the city of Pervomaysk in the Ukraine. I think I had seen that silo before. . . but from a different orientation. On that day, an SS-19 missile, one previously targeted against six American cities, was being withdrawn from the silo and decommissioned. This was a stirring event for both Secretary Perry and I. Both of us spent the early part of our careers developing ballistic missiles. We are now developing the new skills needed to dismantle strategic nuclear forces.

On the same trip, we toured Russia's Engels Air Force Base, where former Soviet bombers were being dismantled with American equipment provided through the Nunn-Lugar program. The use of Nunn-Lugar funds to support weapons dismantlement and defense conversion in the republics of the former Soviet Union is part of our new strategy of "preventive defense," or defense by "other means." Through such preventive measures as the Nunn-Lugar program, the United States is seeking to identify and mitigate potential threats to our security before they can emerge. In truth, preventive defense is nothing new—the Marshall Plan is one famous past use of this sort of program—but the emphasis on preventive defense measures is new. And pursuing a preventive defense strategy requires new knowledge and skills.

In the post-Cold War world, the United States no longer faces a single galvanizing threat such as the former Soviet Union. Instead, there is increased likelihood of our forces being committed to limited regional military actions - coalition

operations -- in which allies are important partners. Deploying forces in coalition operations with the forces of other countries places a high premium on interoperability—that is, ensuring that US and allied systems are compatible and can be sustained through a common logistics support structure. The heightened emphasis on coalition operations, to include operations other than war, is especially important because it comes during a period of declining defense budgets not only in the United States, but around the globe as well.

In this environment, it is clear to me that we will have to leverage the technology and industrial base of all our nations to modernize the equipment of our defense forces at an affordable. The United States and its allies are being challenged to do more with fewer resources. In many areas, the US no longer has the luxury of going it alone.

In addition to the economic and military reasons I have just cited, the United States seeks cooperation with its friends and allies for political reasons as well—these programs help strengthen the connective tissue—the military and industrial relationships that bind our nations in a strong security relationship. The political dimension of armaments cooperation is becoming increasingly important. In June of 1995, the United States hosted—here in Colorado Springs—the first ever offsite meeting of the NATO national armaments directors. In November 1995, we held the first ever meeting of the national armaments directors from the NATO and Partnership for Peace countries—a combined total of 33 countries were represented.

I would sum up our current national security environment in statistical terms by saying that the mean value of our single greatest threat is considerably reduced. But the irony of the situation is that the variance of the collective threat that we must deal with, and plan for, and must counter is up.

This gives us some pause in trying to plan intelligently. In response to reduced mean value of the threat, the United States has cut end strength by about a third from 1985 levels. But at the same time, the increase in variance has caused deployments of U.S. forces to go up by a third. In the defense acquisition and technology program,this means we are focusing on fielding superior operational capability and reducing weapon system life cycle costs.

And we are succeeding in this effort by exploiting the opportunities made possible by the information revolution. As impressive as our military accomplishments were against Saddam Hussein, our forces are qualitatively superior today. The NATO combat operation in Bosnia, Operation DELIBERATE FORCE, showed that—and gave us a hint of what combat will look like in the 21st century.

In DESERT STORM, only two percent of all weapons expended during the air war were precision guided munitions, or PGMs. In Bosnia, they accounted for over 90

percent of all ordnance expended by U.S. forces during Operation DELIBERATE FORCE. The bomb damage assessment photographs in Bosnia bear no resemblance to photos of the past where the target, often undamaged, is surrounded by craters. The photos from Bosnia usually showed one crater where the target used to be, with virtually no collateral damage.

We are moving closer to a situation known as "one target, one weapon." It was actually more than one--but less than two--weapons per target in Operation DELIBERATE FORCE. This has been the promise for the past 20 years, now it is becoming a reality. Our weapons focus now is to preserve accuracy while reducing cost; increasing standoff range; and providing all-weather capability. These are the major imperatives behind our development of systems like the all-weather Joint Direct Attack Munition (JDAM), the Joint Standoff Weapon (JSOW) and the Joint Advanced Standoff Strike Missile (JASSM).

A chess analogy is useful for explaining what this means for the changing nature of warfare. Today, precision weapons have now made it possible to take any piece on any square of the chessboard with no collateral damage to adjacent squares. Given this one target one weapon capability, commanders now need to know where all one's forces are and where all the targets are on a 100 x 200 kilometer battlefield . This is analogous to seeing all the pieces on the chessboard—something we take for granted when playing chess. Imagine how fast you would win the game if you could see all the pieces on the board, but your opponent could see only his major pieces plus a few of your pawns. This is what it means to have "Dominant Battlefield Awareness."

A number of new systems are helping us see all the pieces—JSTARS and unmanned aerial vehicles like the Predator, for example. From the outside, JSTARS, or the Joint Surveillance Target Attack Radar System, looks like an ordinary Boeing 707—one you might expect to find in some commercial air cargo fleets. But inside, the jet is packed with an advanced moving target indicator and synthetic aperture radar and advanced computer processing and communications systems.

The jet is an airborne platform for a powerful surveillance, targeting and battle management system, and we've used these capabilities to great advantage in Bosnia. For example, JSTARS has flown 51 missions in Bosnia, covering a total area of 747 million square kilometers or about 75 times the land area of the United States. On a typical mission, JSTARS spends an average of eight and half hours on station; fills up the 60 Gbytes of mass storage on-board; and acquires 100 radar images at three meter resolution. There have been 38 million total detections and 26,000 total revisits. Over the 51 missions, 6,950 radar service requests were met.

To secure an overwhelming advantage, commanders will need C3 and planning tools to achieve something I call "Dominant Battle Cycle Time"—or the ability to act

before an adversary can react. Back to the chess analogy, dominant battle cycle time would be, well, gaining an unfair advantage by breaking the rules—it means to keep moving your pieces without giving your opponent a chance to move his. To do this on the battlefield, one must have superb command and control systems like JSTARS, fast transportation, and highly mobile maneuver forces.

To support IFOR forces in Bosnia, I recently approved spending about $80 million on an information-communications initiative to be sure we have superb comand, control and communications systems for Operation JOINT ENDEAVOR. The impetus for this initiative came from a 1994 Defense Science Board summer study co-chaired by General Jim McCarthy. This initiative is improving our communications capabilities in two ways: first, by using commercial TV satellite technology to provide a direct broadcast communications capability; and secondly, by fielding a wide bandwidth, secure tactical internet connection through fiber and commercial satellite transponders. These communications allow war planners and logisticians, on the ground in Bosnia, in the European Command Headquarters in Germany and back in the Pentagon to have access to the same data at the same time—this access is available to virtually anyone with a 20 inch receive antenna, cryptologic equipment and authentication codes. We've designed the system in such a way that we are giving local commanders a 5000 mile remote control to select the programming that they receive over their 24 megabits-per-second downlinks from direct broadcast satellites.

There are many striking aspects to this Bosnia Info-Comm initiative. First, we're pushing hard to get the most advanced information capabilities to our forces, and we are succeeding. We've accomplished in four months what it normally takes ten years to do for a new system. Second, we are demonstrating our willingness to use—even to lease—commercial systems. And third, we are proving the need to possess system engineering and system integration skills. This expertise is crucial to developing the multiple application layer architectures needed to tailor information systems for defense needs.

If I compare and contrast today's major Air Force acquisition programs with those that existed 30 years ago, I am led to the conclusion that we are now paying much more attention than we have in the past towards enhancing the performance of our combat platforms with off-board information. In 1966, our focus was on the combat platforms—ships, tanks and planes. The weapons, more often than not, were inertially guided. Today, we have clearly shifted our emphasis towards working with system-of-systems architectures involving sensor, communication, and command and control systems.

In 1966, I had been working on the seeker for the Maverick Missile—when TV video tape recorders were invented. The Maverick, being a TV guided bomb, benefited greatly from this commercial development because we were able to preserve the

television images from flight tests for subsequent analysis and evaluation. In this way, commercial TV video tape recorders helped improved the Maverick missile—one of our first precision guide munitions. It came about because of commercial sector investment in R&D. It is also an early example of a what I would call a "dual use" technology. . . that is, a technology that has both commercial and military applications.

In aggregate terms, commercial industry surpassed the DOD in R&D spending back in 1965. The disparity between defense and commercial sector investment in R&D has been growing wider ever since. This difference means that this nation's technological momentum is driven to a greater extent by commercial market forces.

Today's global economy allows everyone, including our potential adversaries, to gain increasing access to the same commercial technology base. To the extent that commercial technology can enhance military capability, the military advantage will go to the nation who has the best cycle time to capture technologies that are commercially available; incorporate them in weapon systems; and field new operational capabilities first.

In this environment, we have no choice but to move from separate industrial sectors for defense and commercial products to an integrated national industrial base. Leveraging commercial technological advances to create military advantage is critical to ensuring that our equipment remains affordable and the most advanced in the world.

In summary, the fabric of our society is changing. The information revolution is behind many of these changes, and it is having a profound affect on warfare. The possibilities are dazzling, but we must not lose sight of the fact that all this progress depends on a fundamental truth: our military, no matter how technologically sophisticated, is only as good as the people operating the equipment and formulating the strategies—in short, the people who fight our battles. The competitive military advantage really depends on a competitive human advantage.

We are surrounded by change; the world is moving fast, information is moving fast, and information technologies are moving fast. Just as mass production-based manufacturing replaced agriculture in the 19th century, the information age promises to reward the best integrator of knowledge, men and machines in the 21st century. The nation's ability to keep ahead of these changes will depend, in part, on the abilities of everyone in this room.

Expect your career to be at least as diverse as mine. You must be prepared to do more. During my Air Force career, I was afforded the opportunity to recharge my knowledge base at least four times. Early in my career, I improved my understanding of guidance systems in support of assignments to the Minuteman and Maverick missile programs. Next, I learned about developing and fielding space systems, then synthetic

aperture radars and finally, late in my Air Force career, stealth technologies. To prepare for my second career, I learned about investment banking, business financing and commercial technologies. Now I am developing a whole new set of skills in international relations and running multi-service programs.

So the next time you walk by the Eagle and Fledglings, don't think of it as just another memorial with just another inscription. Stop and take the time to reflect upon the enduring truth. Think of it as a personal challenge—because your flight through life will most certainly be sustained by the power of your knowledge and your ability to continue recharging that knowledge.

Thank you all.